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GB 1169620
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(54) **Shelving structure**

(57) The invention concerns a shelving structure erected from members (8, 28) which may be interconnected together vertically. A first component (8) of the shelving structure is provided with projecting formations (12, 18) and a second component is provided with receiving apertures (30) into which the projecting formations may be inserted. By relative vertical movement between the two components the projecting formations co-operate with the receiving apertures to transmit vertical load from one component to the other, the engaging surfaces being so inclined as to "wedge" to prevent relative separative movement between the two components in at least two mutually perpendicular directions.

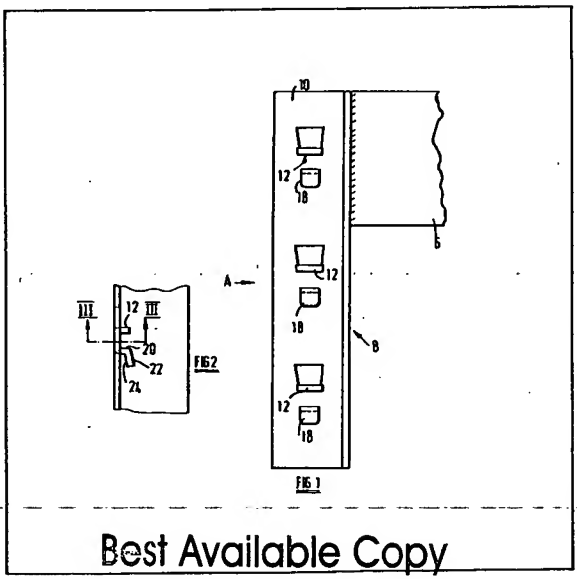

FIG 2

FIG 1

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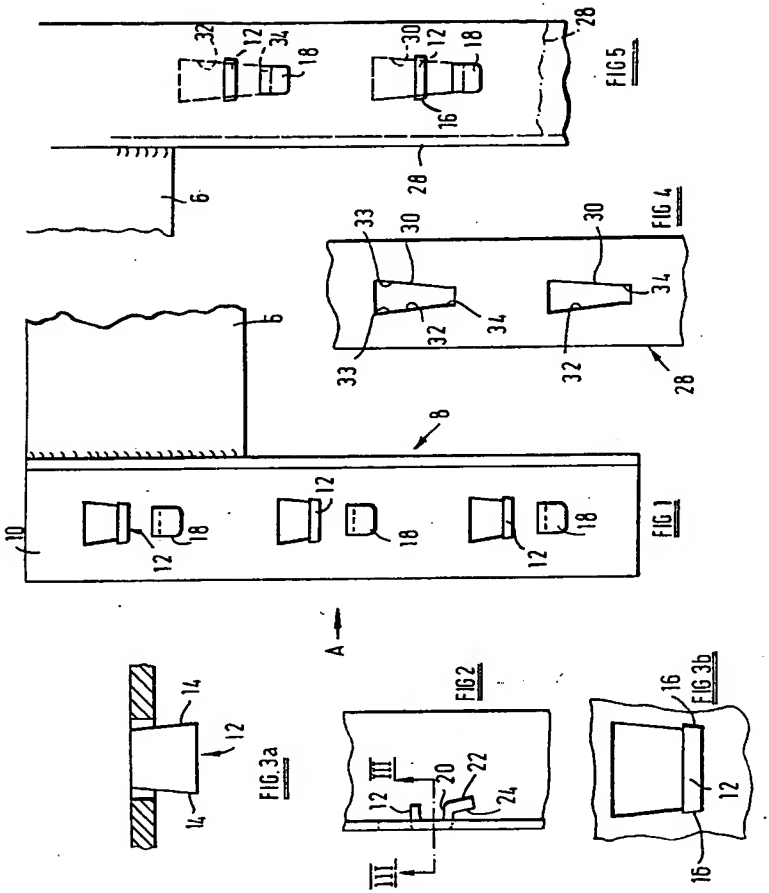
FIG 5
FIG 4
FIG 1
FIG 2
FIG 3a
FIG 3b
A
III
III
6
8
10
12
14
16
18
20
22
24
28
30
32
33
34

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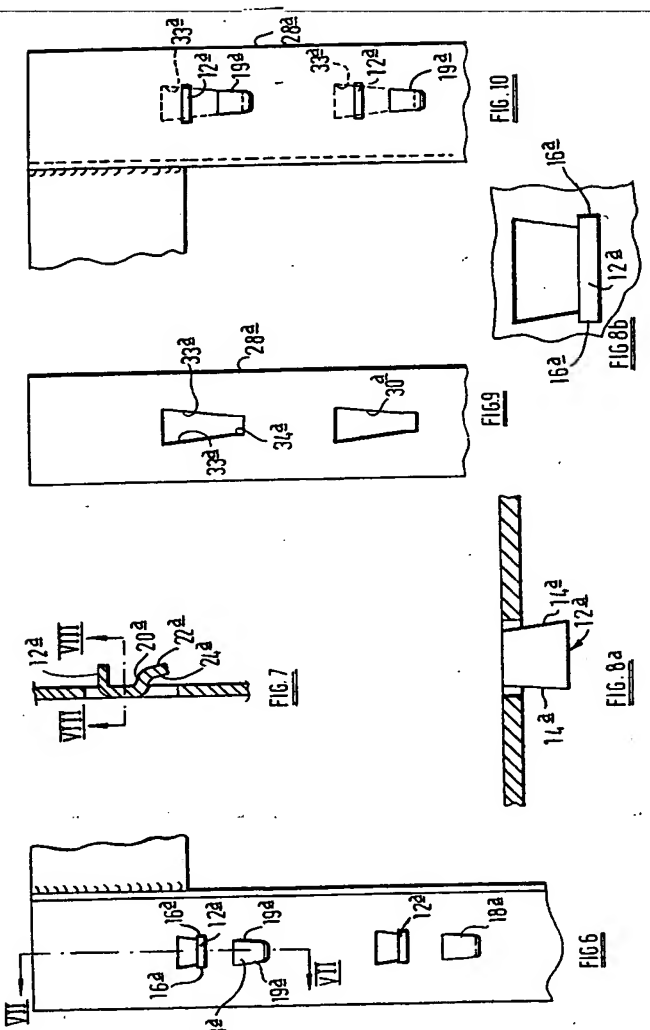
VII
VII
16a
16a
12a
19a
19a
18a
18a
12a
18a
FIG.6
12a
VIII
VIII
20a
22a
24a
FIG.7
14a
12a
14a
FIG.8a
16a
12a
16a
FIG.8b
33a
28a
33a
34a
30a
FIG9
33a
28a
33a
12a
19a
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FIG.10

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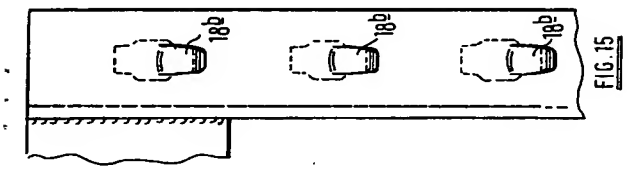

FIG.15

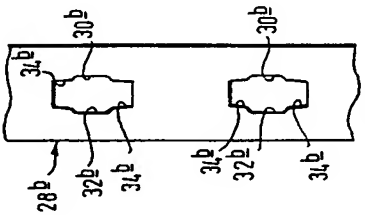

FIG.14

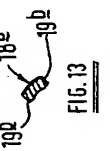

FIG.13

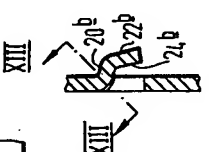

FIG.12

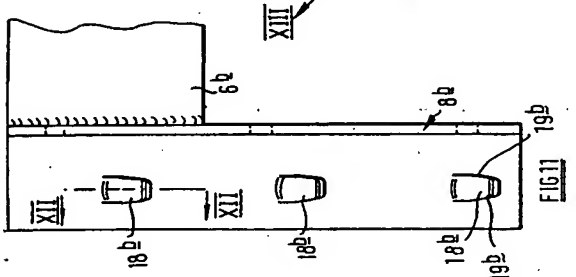

FIG.11

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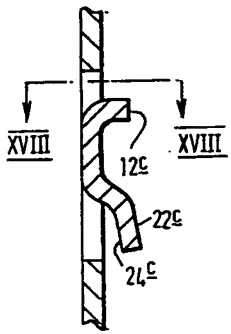

FIG 17

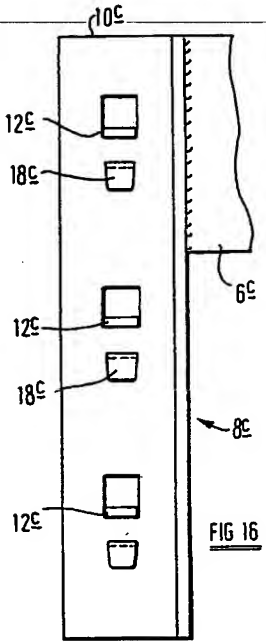

FIG 16

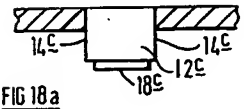

FIG 18a

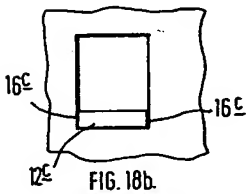

FIG. 18b.

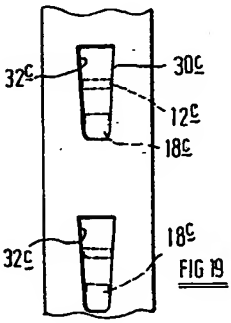

FIG 19

SPECIFICATION

Improvements relating to shelving structures

This invention is concerned with shelving structures, particularly of the kind (hereinafter referred to as being of the kind specified) erected from members which may be interconnected together vertically.

A conventional structure of the kind specified comprises vertical struts, and horizontal beams provided at their end portions with connector members which may be inter-engaged vertically with the struts. For example, the struts may be provided with a number of spaced receiving apertures, and the connector members may be provided with projecting formations adapted to be entered into the receiving apertures by vertical downward movement of the connector member relative to the strut.

In the assembly of shelving structures of the kind specified, difficulty is frequently encountered in the freedom of the elements thereof to undergo relative movement: such movement may be in one horizontal direction (e.g. widthwise of the shelf structure), in another horizontal direction at right angles to said first direction (e.g. depthwise of the shelf structure) or in a vertical direction.

Thus, according to a first aspect of this invention there is provided, in combination, vertically interconnectable components for use in the erection of a shelving structure, and comprising:

(a) a first component provided with projecting formations; and

(b) a second component provided with receiving apertures into which the projecting formations may be inserted, whereby upon insertion of the projecting formations into the receiving apertures a vertical load may be transmitted from one component to the other, and wherein the projecting formations and receiving apertures are provided with surfaces which are mutually inclined and which are adapted to co-operate to restrain relative movement between the two components in at least two mutually perpendicular directions.

The mutually inclined surfaces may co-operate to restrain relative movement between the two components beyond a predetermined amount: thus, said projecting formations and receiving apertures may be so arranged as to permit a small degree of relative movement in at least one of said mutually perpendicular directions prior to engagement of co-operating surfaces to restrain further such movement.

Preferably however, the mutually inclined surfaces co-operate to restrain any significant relative movement in at least one of said mutually perpendicular directions, advantageously by co-operation in a wedging action. Preferably said one direction is one which extends generally parallel to the plane within which the receiving apertures lie.

Preferably said inclined surfaces are so arranged as to become increasingly operative to restrain such relative movement under loading of the shelf structure.

Said mutually perpendicular directions may both be horizontal directions, or one of said directions may be horizontal and the other vertical.

Each projecting formation may be provided by a single projecting component which provides surfaces which co-operate with surfaces of a receiving aperture to restrain relative movement in both said mutually perpendicular directions. Alternatively, each projecting formation may be provided by first and second projecting components, one of which co-operates with the receiving aperture to restrain relative movement in a first of said mutually perpendicular directions, the other of which cooperates with the or another aperture to restrain relative movement in a second of said mutually perpendicular directions.

According to this invention there is also provided, in combination, vertically inter-connectable elements for use in the erection of a shelving structure and comprising:

(a) a first member provided with projecting elements; and

(b) a second member provided with receiving apertures into which the projecting elements may be inserted, whereby upon insertion of the projecting elements into the receiving apertures a vertical load may be transmitted from one member to the other, wherein each projecting element comprises a shoulder portion extending out of the plane of the first member and a terminal portion integral with the shoulder portion and which is inclined at an acute angle to the plane of the first member, said terminal portion being tapered in a horizontal direction, and wherein each receiving aperture comprises a central portion and a lower portion comprising side edges which converge in the direction away from the central portion.

In this manner, the tapered terminal portion of each projecting element may be engaged between the side edges of the lower portion of each receiving formation in a wedging action, tending to restrain relative movement between the first and second members in both of the mutually perpendicular horizontal directions.

Preferably, the terminal portion of each projecting element is curved in cross-section. Preferably each receiving aperture has an upper portion comprising side edges which converge in the vertical direction away from the central portion: in this manner, a projecting element may be engaged with each receiving aperture by passage through the central portion thereof, and downward movement into engagement with the convergent side edges, whatever the vertical orientation of the second member.

According to this invention there is also provided, in combination, vertically interconnectable components for use in the erection of a shelving structure, and comprising a first component provided with projecting formations, and a second component provided with receiving formations, the construction and arrangement being such that when the two components are placed face to face, the projecting formations extend into the receiving formations,

wherein the receiving formations comprise downwardly convergent side faces, and the projecting formations comprise flanged elements adapted to embrace the second component to restrain relative movement between the two components in a direction at right angles to the plane of said faces of the components, and wedge elements adapted to engage in a wedging action with the convergent sides of the receiving formations.

The wedge elements may also have downwardly convergent side faces, or may have parallel side faces, the wedge elements may have convergent side faces in plan, or may have parallel side faces in plan.

According to this invention there is provided a shelving structure of the kind specified, wherein the connector members comprise three of more projecting formations, adapted to be entered into the receiving apertures by vertical downward movement of the connector member relative to the strut, and wherein a central one of said three projecting formations is off-set from a line joining the centres of the other two projecting formations.

The invention set out in the last preceding paragraph may particularly be used in a shelf structure of the kind set out in the paragraph preceding said last preceding paragraph.

In this manner, the shelving structure may be manufactured from tools for a greater length of time without requiring replacement of the tools, and/or with the use of greater manufacturing tolerances, whilst maintaining or improving the stiffness of the shelf construction.

There will now be given detailed descriptions, to be read with reference to the accompanying drawings, of four combinations of vertically interconnectable components which have been selected for the purposes of illustrating this invention by way of example.

In the accompanying drawings:—

FIGURE 1 is a side elevation of part of a horizontal component of the combination which is the first embodiment of this invention, illustrating a connector member thereof;

FIGURE 2 is a side elevation on Figure 1, viewed in the direction of the arrow A in Figure 1;

FIGURE 3*a* is an enlarged sectional view on Figure 2, taken along the line III-III of Figure 2;

FIGURE 3*b* is an enlarged view in side elevation of one of the projecting elements shown in Figure 1;

FIGURE 4 is a side elevation of part of a vertical component of said combination, illustrating receiving formations thereof;

FIGURE 5 is a side elevation showing the manner of interconnection of the connector member of the horizontal component with the vertical component;

FIGURE 6 is a front elevation of part of a horizontal component of the combination which is the second embodiment of this invention, showing the connector member thereof;

FIGURE 7 is a cross-sectional view of said connector member, taken along the lines VII-VII of Figure 6;

FIGURE 8*a* is an enlarged sectional view, taken on the line VIII-VIII of Figure 7;

FIGURE 8*b* is an enlarged view in side elevation of one of the projecting elements shown in Figure 6;

FIGURE 9 is a front elevation of a vertical component of said combination;

FIGURE 10 is a view illustrating the manner of interconnection of the connector member of the horizontal component with the vertical component;

FIGURE 11 is a front elevation of the horizontal component of the combination which is the third embodiment of this invention showing the connector member thereof;

FIGURE 12 is a cross-sectional view of part of the connector member, taken along the line XII-XII of Figure 11;

FIGURE 13 is a view of a projecting element of the connector shown in Figure 12, as viewed along the section line XIII-XIII in Figure 12;

FIGURE 14 is a side elevation of a vertical component of the third combination, showing receiving formations thereof;

FIGURE 15 is a side elevation showing the manner of interconnection of the connector of the horizontal component with the vertical component in said third embodiment;

FIGURE 16 is a side elevation of part of a horizontal component of the combination which is fourth embodiment of this invention, illustrating a connector member thereof;

FIGURE 17 is a side elevation on Figure 16, viewed in the direction of the arrow A of Figure 16;

FIGURE 18*a* is an enlarged sectional view on Figure 17, taken along the line XVIII-XVIII of Figure 17;

FIGURE 18*b* is an enlarged view in side elevation of one of the projecting elements shown in Figure 16; and

FIGURE 19 is a side elevation of part of a vertical component of said combination, illustrating receiving formations thereof.

The combination which is the first embodiment of this invention comprises a horizontal component, afforded by a beam 6 having secured thereto at each end portion a connector member 8 afforded by an angled plate, the connector member at one end of the beam 6 being shown in Figure 1.

The connector member 8 is provided with a number of projecting components pressed from one side face 10 thereof, said projecting formations each comprising a first projecting component 12 and a second projecting component 18 pressed out of the plane of that face of the component on which they are provided.

Each first projecting element 12 is in the form of a flat tab, and is wedge-shaped, comprising convergent side faces 14, 14, as seen in plan (Figure 3*a*). The projecting element 12 also comprises downwardly convergent edge faces 16, 16 (Figures 1 and 3*b*). Each second projecting element 18 is in the form of a hook-like flange, and comprises a first shoulder portion 20 extending from the side face 10 generally at right angles thereto, and a second terminal portion 22 which is inclined downwardly (Figure 2) and which provides an inclined inside face 24.

The first embodiment also comprises a vertical component afforded by a strut 28 (Figure 4) which is hollow, rectangular in cross-section. On at least two, and preferably all of the side faces, the strut is pro-

vided with a number of uniformly-spaced receiving formations provided by apertures 30 pressed out of the component. Each aperture 30 comprises an upper portion 32, comprising convergent surfaces 33, 33, and a lower portion 34 having parallel side faces.

In the erection of a shelf structure from the components illustrated in Figures 1 to 4, the strut 28 will be placed vertically, and the connector member of a beam 6 will be interengaged vertically with said strut, in face-to-face contact therewith, with the connector member embracing two adjacent (mutually perpendicular) sides of the strut 28, and the projecting formations extend into the receiving apertures 30. Such insertion will be undertaken with the projecting formations initially in a higher position relative to the receiving apertures, which allows ease of entry of the projecting formations into the apertures 30, by virtue of the wider, upper portion of the apertures. The beam 6 and connector member 8 will then be lowered relative to the strut, to the position generally shown in Figure 5. The dimensions of the projecting formations and the receiving apertures is such that, just prior to the portion 20 of the second component 18 engaging the lower face of the aperture 30, the projecting element 12 will enter into a wedging engagement with the inclined surfaces 33. In particular, the side faces 14, 14 of the component 12 engage with the surfaces 33, 33 defining the upper portion of the aperture 30, wedging the connector member, and hence the beam, against any movement relative to the strut in a first horizontal direction, particularly one which lies generally parallel to the plane within which the receiving apertures 30 lie.

Additionally however, the edge faces 16 of the component 12 also engage with the surfaces 33 of the aperture 30, preventing relative horizontal movement between the connector member 8, and hence of the beam 6, relative to the struts 28 in a second horizontal direction extending at right angles to said first horizontal direction (specifically a direction which extends in a depthwise direction).

It will be appreciated that the construction and arrangement of the first projecting element 12 and the complementary portion of the receiving aperture 30 is such that, when load is applied to the beam 6, the effect of the interengagement of the surfaces of the element 12 with the surfaces bounding the aperture 30 will increase.

In the first embodiment, the construction and arrangement is such that the element 12 enters into engagement with the aperture 30 before contact between the portion 20 of the component 18 and the base of the aperture 30. Thus, the transmission of vertical load from the beam 6 through the connector member 8 to the strut 20 is effected primarily through the elements 12.

The combination which is the second embodiment is similar in certain aspects to that which is the first embodiment, and the same numerals have been used to denote similar parts, with the suffix *a*.

However whereas in the first embodiment the second projecting element 18 has parallel vertical sides (shown in Figure 1), in the second embodiment the corresponding elements 18*a* has mutually convergent edge faces 19, 19. Conversely, the first projecting element 12*a* of the second embodiment has parallel edge faces 16*a*, 16*a*.

The vertical component is afforded by a strut 28*a* having receiving formations afforded by apertures 30*a*, similar to the apertures of the strut of the first embodiment. However on the insertion of the first projecting formation, comprising elements 12*a* and elements 18*a*, into each slot 30*a*, the side faces 14*a*, 14*a* of the first projecting element 12*a* engage with the inclined surfaces 33*a*, 33*a* of the upper portion of the aperture 30*a* in a wedging action, as described in the arrangement of the first embodiment, whilst the edge faces 19, 19 of the second projecting element 18*a* enter into a wedging engagement with the parallel surfaces of the lower portion 34 of the aperture 30.

Thus, the second projecting element cooperates within the slot 30*a* in a wedging action to prevent relative movement between the connector member 8*a*, and hence the beam 6*a*, and the strut 28*a*, in a horizontal direction generally parallel to the plane of the apertures 30*a*, whilst the first projecting element 12*a* cooperates within the aperture 38 to prevent such relative movement in a second horizontal direction extending at right angles to the first horizontal direction.

The combination which is the third embodiment of this invention is also similar in certain aspects to that which is the first embodiment, and similar numerals have been used to denote similar parts, with the suffix *b*.

However, whereas in the first embodiment each projecting formation comprises projecting elements 12 and 18, in the third embodiment each projecting formation comprises solely a projecting element 18*b*, said projecting element comprises a shoulder portion 20*b* and a terminal portion 22*b* having an inside face 24*b* which is inclined at an acute angle to the plane of the vertical element from which it projects.

Additionally, in the third embodiment, as in the second embodiment, the portion 22*b* of the element 18*b* has mutually convergent edge faces 19*b*. Further, as is shown in Figure 13, the portion 22*b* of said element 18*b* is arcuate in cross-section.

In the third embodiment, the vertical component, afforded by the struts 28*b* (Figure 14) is provided with receiving formations afforded by apertures 30*b*. Each aperture 30*b* comprises a central portion 32*b*, and upper and lower portions 34*b*, side edges of the upper and lower portions 34*b* converging in the vertical direction away from the central portion 32.

In this manner, the connector 8*b* may be interengaged vertically with the strut 28*b* by passing projecting elements 18*b* through the central, wider portions 32*b* of the apertures 30*b* and sliding the connector member 8*b* downwardly until the convergent edge faces 19*b* of the elements 18*b* each engage, in a wedging action, with the convergent side edges of the lower portions of the respective apertures.

In this manner, the connector member 18*b* may be held in relation to the strut 28*b* in a manner in which both side-to-side relative movement, and front-to-

back relative movement therebetween is prevented.

In the third embodiment, the apertures 30*b* are symetrical about lines extending at right angles to the longitudinal axis of the strut: in this manner, the elements 18*b* of a connector member may be interengaged with the strut, irrespective of which way up the strut is.

In the third embodiment, the central projecting element 18*b* is offset from a line joining the centres of the upper and lower formations of the connector member, to an extent greater than the tolerances of manufacture. Thus (as is common practice) where the manufacturing tolerances of the tongues and receiving apertures are plus or minus 0.002 inches, preferably the degree of offset is between 0.002 inches and 0.010 inches, and preferably between 0.004 inches and 0.006 inches.

In this manner, firstly a more convenient manufacture is facilitated. Thus, where on conventional in line construction, the formation of the projecting elements is effected to minimum permissible size, and formation of the receiving apertures is effected to maximum permissible size, the side edges of the projecting elements could engage the bottom faces of the slots, as distinct from the side edges of the lower portions 34*b* of the slots. This tendency is exacerbated after a small degree of wear of the tools by which the struts and connector members are manufactured, or of the elements of the shelving structure itself. By offsetting of the central projecting formation, bearing in mind that the connector member will to some extent be flexible, the projecting formations would nontheless frictionally engage the side edges of their respective aperture portions.

Additionally, the offset arrangement allows the use of manufacturing tools for a greater length of time without requiring them to be replaced, and/or the use of greater manufacturing tolerances, whilst maintaining or improving the stiffness of the shelving structure.

However it is to be appreciated that the offset construction described in relation to the third embodiment in the last three preceding paragraphs may also be used to advantage in the first and second embodiments hereinabove described, and in the fourth embodiment, hereinafter described.

The combination which is the fourth embodiment of this invention is also similar in certain aspects to that which is the first embodiment, and the same numerals have been used to denote similar parts, with the suffix *c*.

Thus whilst in the first embodiment, each first projecting element 12 is wedge-shaped, as seen in plan, in the fourth embodiment each projecting element 12*c* has parallel side faces 14*c*, 14*c*. Additionally, whilst in the first embodiment each projecting element 12 also comprises downwardly-convergent faces 16, 16, in the fourth embodiment the element 12*c* comprises parallel edge faces 16*c*, 16*c* (see Figures 18*a* and 18*b*).

Further, whilst in the first embodiment the vertical strut 28 is afforded with apertures 30, a lower portion 34 of which has parallel side faces, in the fourth embodiment the strut 28*c* has apertures 30*c* which do not terminate in such parallel side faces.

Thus in the fourth embodiment, the wedge elements 12*c* are rectangular in horizontal and vertical cross-section, and effect a wedging action with the receiving formations 30*c* by virtue of the convergent surfaces 33*c*, 33*c* thereof.

It is to be appreciated that, whilst the conponents of the shelving structure have been described hereinbefore with the component 6 extending horizontally, and the component 28 extending vertically, these relative orientations will only be adopted when the two components are interfitted, and that the expressions "vertical" and "horizontal" are not to be taken as limiting the scope of this invention to the components when in any precise orientation.

CLAIMS

1. In combination vertically interconnectable components for use in the erection of a shelving structure and comprising:

(a) a first component provided with projecting formations; and

(b) a second component provided with receiving apertures into which the projecting formations may be inserted, whereby upon insertion of the projecting formations into the receiving apertures a vertical load may be transmitted from one component to the other, and wherein the projecting formations and receiving apertures are provided with surfaces which are mutually inclined and which are adapted to co-operate to restrain relative movement between the two components in at least two mutually perpendicular directions.

2. The combination according to claim 1 wherein said mutually inclined surfaces are adapted to co-operate to restrain relative movement between the two components beyond a predetermined amount.

3. The combination according to claim 2 wherein said projecting formations and receiving apertures are so arranged as to permit a small degree of relative movement in at least one of said mutually perpendicular directions prior to engagement of co-operating surfaces to restrain further such movement.

4. The combination according to any one of the preceding claims wherein said mutually inclined surfaces co-operate to restrain any significant relative movement in at least one of said mutually perpendicular directions.

5. The combination according to claim 4 wherein such restraint is effected by a wedging action.

6. The combination according to one of claims 4 and 5 wherein said one direction extends generally parallel to the plane within which the receiving apertures lie.

7. The combination according to any one of the preceding claims wherein said inclined surfaces are so arranged as to become increasingly operative to restrain such relative movement under loading of the shelf structure.

8. The combination according to any one of the preceding claims wherein said mutually perpendicular directions are both horizontal directions.

9. The combination according to any one of claims 1 to 7 wherein one of said mutually perpendicular directions is horizontal and the other vertical.

10. The combination according to any one of the

preceding claims wherein each projecting formation is provided by a single projecting component which provides surfaces which co-operate with surfaces of a receiving aperture to restrain relative movement in both said mutually perpendicular directions.

11. The combination according to any one of claims 1 to 9 wherein each projecting formation is provided by first and second projecting components, one of which co-operates with the receiving aperture to restrain relative movement in a first of said mutually perpendicular directions, the other of which co-operates with the or another aperture to restrain relative movement in a second of said mutually perpendicular directions.

12. In combination, vertically interconnectable elements for use in the erection of a shelving structure and comprising:

(a) a first member provided with projecting elements;

(b) a second member provided with receiving apertures into which the projecting elements may be inserted, whereby upon insertion of the projecting elements into the receiving apertures a vertical load may be transmitted from one member to the other, wherein each projecting element comprises a shoulder portion extending out of the plane of the first member and a terminal portion inclined with the shoulder portion and which is inclined at an acute angle to the plane of the first member, said terminal portion being tapered in a horizontal direction, and wherein each receiving aperture comprises a central portion and a lower portion comprising side edges which converge in a direction away from the central portion.

13. The combination according to claim 12 wherein, on assembly of the members together, the tapered terminal portion of each projecting element engages between the side edges of the lower portion of each receiving formation in a wedging action, tending to restrain relative movement between the first and second members in both of the mutually perpendicular horizontal directions.

14. The combination according to one of claims 12 and 13 wherein the terminal portion of each projecting element is curved in cross-section.

15. The combination according to any one of claims 12, 13 and 14 wherein each receiving aperture has an upper portion comprising side edges which converge in the vertical direction away from the central portion.

16. In combination, vertically interconnectable components for use in the erection of a shelving structure, and comprising:

(a) a first component provided with projecting formations; and

(b) a second component provided with receiving apertures, the construction and arrangement being such that when the two components are placed face-to-face, the projecting formations extend into the receiving apertures,

wherein the receiving apertures comprise downwardly convergent side faces and the projecting formations comprise flanged elements adapted to embrace the second component to restrain relative movement between the two components in a direction at right angles to the plane of said faces of the components, and wedge elements adapted to engage in a wedging action with the convergent sides of the receiving formations.

17. The combination according to claim 16 wherein the wedge elements have downwardly convergent side faces.

18. The combination according to claim 16 wherein the wedge elements have parallel side faces.

19. The combination according to any one of claims 16 to 18 wherein the wedge elements have convergent side faces in plane.

20. The combination according to any one of claims 16 to 18 wherein the wedge elements have parallel side faces in plane.

21. A shelving structure of the kind specified wherein the connector members comprise three or more projecting formations, adapted to be entered into the receiving apertures by vertical downward movement of the connector members relative to the strut, and wherein a central one of said three projecting formations is offset from a line joining the centres of the other two projecting formations.

22. The combination according to any one of claims 1 to 20, comprising a connector member according to claim 21.

23. In combination, vertically interconnectable elements for use in the erection of a shelving structure, constructed and arranged substantially as hereinbefore described.

(a) with reference to Figures 1 to 5;

(b) with reference to Figures 6 to 10;

(c) with reference to Figures 11 to 15;

(d) with reference to Figures 16 to 19 of the accompanying drawings.

24. Any novel feature or novel combination of features hereinbefore described and/or shown in the accompanying drawings.

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